

the complete engine under the maximum conditions of engine acceleration/deceleration rate, speed, torque, and temperature as specified by the applicant. The propeller must be stopped prior to brake release.

(c) One hundred engine starts and stops with the propeller brake engaged.

(d) The tests required by paragraphs (a), (b), and (c) of this section must be performed on the same engine, but this engine need not be the same engine used for the tests required by § 33.87.

(e) The tests required by paragraphs (a), (b), and (c) of this section must be followed by engine disassembly to the extent necessary to show compliance with the requirements of § 33.93(a) and § 33.93(b).

[Amdt. 33-11, 51 FR 10346, Mar. 25, 1986]

§ 33.97 Thrust reversers.

(a) If the engine incorporates a reverser, the endurance calibration, operation, and vibration tests prescribed in this subpart must be run with the reverser installed. In complying with this section, the power control lever must be moved from one extreme position to the other in not more than one second except, if regimes of control operations are incorporated necessitating scheduling of the power-control lever motion in going from one extreme position to the other, a longer period of time is acceptable but not more than three seconds. In addition, the test prescribed in paragraph (b) of this section must be made. This test may be scheduled as part of the endurance run.

(b) 175 reversals must be made from flight-idle forward thrust to maximum reverse thrust and 25 reversals must be made from rated takeoff thrust to maximum reverse thrust. After each reversal the reverser must be operated at full reverse thrust for a period of one minute, except that, in the case of a reverser intended for use only as a braking means on the ground, the reverser need only be operated at full reverse thrust for 30 seconds.

[Doc. No. 3025, 29 FR 7453, June 10, 1964, as amended by Amdt. 33-3, 32 FR 3737, Mar. 4, 1967]

§ 33.99 General conduct of block tests.

(a) Each applicant may, in making a block test, use separate engines of identical design and construction in the vibration, calibration, endurance, and operation tests, except that, if a separate engine is used for the endurance test it must be subjected to a calibration check before starting the endurance test.

(b) Each applicant may service and make minor repairs to the engine during the block tests in accordance with the service and maintenance instructions submitted in compliance with § 33.4. If the frequency of the service is excessive, or the number of stops due to engine malfunction is excessive, or a major repair, or replacement of a part is found necessary during the block tests or as the result of findings from the teardown inspection, the engine or its parts must be subjected to any additional tests the Administrator finds necessary.

(c) Each applicant must furnish all testing facilities, including equipment and competent personnel, to conduct the block tests.

[Doc. No. 3025, 29 FR 7453, June 10, 1964, as amended by Amdt. 33-6, 39 FR 35470, Oct. 1, 1974; Amdt. 33-9, 45 FR 60181, Sept. 11, 1980]

Subpart G—Special Requirements: Turbine Aircraft Engines

SOURCE: Docket No. FAA-2002-6717, 72 FR 1877, Jan. 16, 2007, unless otherwise noted.

§ 33.201 Design and test requirements for Early ETOPS eligibility.

An applicant seeking type design approval for an engine to be installed on a two-engine airplane approved for ETOPS without the service experience specified in part 25, Appendix K, K25.2.1 of this chapter, must comply with the following:

(a) The engine must be designed using a design quality process acceptable to the FAA, that ensures the design features of the engine minimize the occurrence of failures, malfunctions, defects, and maintenance errors that could result in an IFSD, loss of thrust control, or other power loss.

(b) The design features of the engine must address problems shown to result

in an IFSD, loss of thrust control, or other power loss in the applicant's other relevant type designs approved within the past 10 years, to the extent that adequate service data is available within that 10-year period. An applicant without adequate service data must show experience with and knowledge of problem mitigating design practices equivalent to that gained from actual service experience in a manner acceptable to the FAA.

(c) Except as specified in paragraph (f) of this section, the applicant must conduct a simulated ETOPS mission cyclic endurance test in accordance with an approved test plan on an engine that substantially conforms to the type design. The test must:

(1) Include a minimum of 3,000 representative service start-stop mission cycles and three simulated diversion cycles at maximum continuous thrust or power for the maximum diversion time for which ETOPS eligibility is sought. Each start-stop mission cycle must include the use of take-off, climb, cruise, descent, approach, and landing thrust or power and the use of thrust reverse (if applicable). The diversions must be evenly distributed over the duration of the test. The last diversion must be conducted within 100 cycles of the completion of the test.

(2) Be performed with the high speed and low speed main engine rotors independently unbalanced to obtain a minimum of 90 percent of the recommended field service maintenance vibration levels. For engines with three main engine rotors, the intermediate speed rotor must be independently unbalanced to obtain a minimum of 90 percent of the recommended production acceptance vibration level. The required peak vibration levels must be verified during a slow acceleration and deceleration run of the test engine covering the main engine rotor operating speed ranges.

(3) Include a minimum of three million vibration cycles for each 60 rpm incremental step of the typical high-speed rotor start-stop mission cycle. The test may be conducted using any rotor speed step increment from 60 to 200 rpm provided the test encompasses the typical service start-stop cycle speed range. For incremental steps

greater than 60 rpm, the minimum number of vibration cycles must be linearly increased up to ten million cycles for a 200 rpm incremental step.

(4) Include a minimum of 300,000 vibration cycles for each 60 rpm incremental step of the high-speed rotor approved operational speed range between minimum flight idle and cruise power not covered by paragraph (c)(3) of this section. The test may be conducted using any rotor speed step increment from 60 to 200 rpm provided the test encompasses the applicable speed range. For incremental steps greater than 60 rpm the minimum number of vibration cycles must be linearly increased up to 1 million for a 200 rpm incremental step.

(5) Include vibration surveys at periodic intervals throughout the test. The equivalent value of the peak vibration level observed during the surveys must meet the minimum vibration requirement of § 33.201(c)(2).

(d) Prior to the test required by paragraph (c) of this section, the engine must be subjected to a calibration test to document power and thrust characteristics.

(e) At the conclusion of the testing required by paragraph (c) of this section, the engine must:

(1) Be subjected to a calibration test at sea-level conditions. Any change in power or thrust characteristics must be within approved limits.

(2) Be visually inspected in accordance with the on-wing inspection recommendations and limits contained in the Instructions for Continued Airworthiness submitted in compliance with § 33.4.

(3) Be completely disassembled and inspected—

(i) In accordance with the applicable inspection recommendations and limits contained in the Instructions for Continued Airworthiness submitted in compliance with § 33.4;

(ii) With consideration of the causes of IFSD, loss of thrust control, or other power loss identified by paragraph (b) of this section; and

(iii) In a manner to identify wear or distress conditions that could result in an IFSD, loss of thrust control, or other power loss not specifically identified by paragraph (b) of this section

or addressed within the Instructions for Continued Airworthiness.

(4) Not show wear or distress to the extent that could result in an IFSD, loss of thrust control, or other power loss within a period of operation before the component, assembly, or system would likely have been inspected or functionally tested for integrity while in service. Such wear or distress must have corrective action implemented through a design change, a change to maintenance instructions, or operational procedures before ETOPS eligibility is granted. The type and frequency of wear and distress that occurs during the engine test must be consistent with the type and frequency of wear and distress that would be expected to occur on ETOPS eligible engines.

(f) An alternative mission cycle endurance test that provides an equivalent demonstration of the unbalance and vibration specified in paragraph (c) of this section may be used when approved by the FAA.

(g) For an applicant using the simulated ETOPS mission cyclic endurance test to comply with §33.90, the test may be interrupted so that the engine may be inspected by an on-wing or other method, using criteria acceptable to the FAA, after completion of the test cycles required to comply with §33.90(a). Following the inspection, the ETOPS test must be resumed to complete the requirements of this section.

APPENDIX A TO PART 33—INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

A33.1 GENERAL

(a) This appendix specifies requirements for the preparation of Instructions for Continued Airworthiness as required by §33.4.

(b) The Instructions for Continued Airworthiness for each engine must include the Instructions for Continued Airworthiness for all engine parts. If Instructions for Continued Airworthiness are not supplied by the engine part manufacturer for an engine part, the Instructions for Continued Airworthiness for the engine must include the information essential to the continued airworthiness of the engine.

(c) The applicant must submit to the FAA a program to show how changes to the Instructions for Continued Airworthiness made by the applicant or by the manufacturers of engine parts will be distributed.

A33.2 FORMAT

(a) The Instructions for Continued Airworthiness must be in the form of a manual or manuals as appropriate for the quantity of data to be provided.

(b) The format of the manual or manuals must provide for a practical arrangement.

A33.3 CONTENT

The contents of the manual or manuals must be prepared in the English language. The Instructions for Continued Airworthiness must contain the following manuals or sections, as appropriate, and information:

(a) *Engine Maintenance Manual or Section.*

(1) Introduction information that includes an explanation of the engine's features and data to the extent necessary for maintenance or preventive maintenance.

(2) A detailed description of the engine and its components, systems, and installations.

(3) Installation instructions, including proper procedures for uncrating, deinhibiting, acceptance checking, lifting, and attaching accessories, with any necessary checks.

(4) Basic control and operating information describing how the engine components, systems, and installations operate, and information describing the methods of starting, running, testing, and stopping the engine and its parts including any special procedures and limitations that apply.

(5) Servicing information that covers details regarding servicing points, capacities of tanks, reservoirs, types of fluids to be used, pressures applicable to the various systems, locations of lubrication points, lubricants to be used, and equipment required for servicing.

(6) Scheduling information for each part of the engine that provides the recommended periods at which it should be cleaned, inspected, adjusted, tested, and lubricated, and the degree of inspection the applicable wear tolerances, and work recommended at these periods. However, the applicant may refer to an accessory, instrument, or equipment manufacturer as the source of this information if the applicant shows that the item has an exceptionally high degree of complexity requiring specialized maintenance techniques, test equipment, or expertise. The recommended overhaul periods and necessary cross references to the Airworthiness Limitations section of the manual must also be included. In addition, the applicant must include an inspection program that includes the frequency and extent of the inspections necessary to provide for the continued airworthiness of the engine.

(7) Troubleshooting information describing probable malfunctions, how to recognize those malfunctions, and the remedial action for those malfunctions.